PATENT ABSTRACTS OF JAPAN

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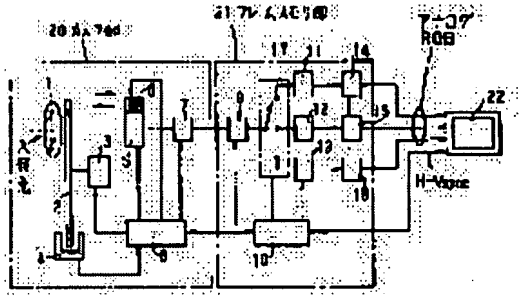
(72)Inventor : HAGA SHUNICHI

(54) SEQUENTIAL PLANE COLOR CAMERA

(57)Abstract:

PURPOSE: To obtain a picked-up image of high quality with a simple device constitution by moving an image pickup element in the optical-axis direction to correct the deviation of the image forming position due to the chromatic aberration on the axis.

CONSTITUTION: A camera control circuit 8 generates a moving signal for the purpose of moving an image pickup element 5 in the optical-axis direction of an arrow by colors and supplies this signal to an image pickup element moving part 6. Then, a prescribed voltage is supplied to a piezoelectric element, which moves the image pickup element 5, with respect to each color to control, the image pickup element 5 so that the image forming position of picture light of each color and the image forming face of the image pickup element 5 coincide with each other. The camera control circuit 8 stores data, which indicates a required magnitude of the moving signal for each color supplied to the image pickup element moving part 6, in a prescribed memory and reads out data in this memory to generate the image pickup element moving signal for each color.



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CLAIMS

[Claim(s)]
[Claim 1] The color separation filter for separating the color of the image light of a photographic subject, and obtaining the image light of each primary color, It is the Junji Men color camera which has the image sensor which carries out the sequential image pick-up of the image light of each primary color obtained with this color separation filter, and is changed into an electrical signal. The Junji Men color camera characterized by providing the driving means which moves said image sensor in the direction of an optical axis corresponding to each color in order to remove the axial overtone aberration for every color of the image light whose color was separated with said color separation filter.
[Claim 2] Said driving means is a Junji Men color camera according to claim 1 with which the color boundary of said color separation filter is characterized by carrying out migration control of said image sensor during the color mixture period which passes through the image pick-up screen top of said image sensor.
[Claim 3] Said driving means is a Junji Men color camera according to claim 1 characterized for performing the location of said image sensor even before said image sensor starts the image pick-up of the image light of each primary color by things.
[Claim 4] Said driving means is a Junji Men color camera according to claim 1 characterized for moving said image sensor based on said data which possessed the storage means for memorizing the data in which the movement magnitude or the location of said image sensor computed beforehand is shown, and were memorized by this storage means by things.
[Claim 5] Said driving means is a Junji Men color camera according to claim 1 characterized by providing the piezoelectric device for moving said image sensor.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the Junji Men color camera from which the bad influence by the axial overtone aberration of optical system was removed by moving an image sensor in the direction of an optical axis about the plane sequence following color camera.
[0002]
[Description of the Prior Art] Conventionally, after separating the color of the image light of a photographic subject with a color separation filter through an image pick-up lens, the Junji Men color camera which picturizes with an image sensor like CCD and acquires a picture signal is known. With such a Junji Men color camera, the color field which makes a color separation filter penetrate only the light of each primary color is prepared, this color separation filter is rotated and the image light for every primary color is obtained. However, generally, since refractive indexes differ according to the wavelength of incident light, an image pick-up lens produces the optical path difference for every primary color, and the difference of a focal location according to the wavelength of incident light. This is the so-called axial overtone aberration, and it produces un-arranging [that the image formation side of a photographic subject image shifts for every primary color also in the case of said Junji Men color camera].
[0003] Conventionally, in order to remove such axial overtone aberration in the plane sequence following color camera, what amends by changing the thickness of the filter field for every primary color of a color separation filter is known (JP,6-54331,A). That is, in the Junji Men color camera of this conventional example, thickness of the filter of red with long wavelength (R) was made thin, and the filter of green with more short wavelength (G) was thickened, and has amended the gap of the focal location by the wavelength of incident light by this.
[0004]
[Problem(s) to be Solved by the Invention] However, in the above conventional Junji Men color cameras, having manufactured what has the filter field where thickness differs for every primary color as a color separation filter, and manufacture of the filter of such structure having un-arranged [that manufacture cost becomes high] to the difficult top. Moreover, since the thickness of a filter differed for every primary color, it was difficult for the weight balance of a color separation filter to become uneven, and for it to become difficult to carry out the rotation drive of the color separation filter at high speed, therefore to realize the Junji Men color camera in which high-speed photography is possible according to such structure.
[0005] that by which this invention was made in view of the trouble in such a conventional camera -- it is -- a plane sequence -- it is in removing the axial overtone aberration of optical system exactly, having it with easy structure, and enabling it to obtain the color picture of high quality in a color [degree] camera.
[0006]
[Means for Solving the Problem] The color separation filter for according to this invention, separating the color of the image light of a photographic subject, and obtaining the image light of each primary color, in order to attain the above-mentioned purpose, In the Junji Men color camera which has the image sensor which carries out the sequential image pick-up of the image light of each primary color obtained with this color separation filter, and is changed into an electrical signal In order to remove the axial overtone aberration for every color of the image light whose color was separated with said color separation filter, the driving means which moves said image sensor in the direction of an optical axis corresponding to each color is established.
[0007] Said driving means is convenient if the color boundary of said color separation filter carries out migration control of said image sensor during the color mixture period which passes through the image pick-up screen top of said image sensor.
[0008] What is necessary is just to constitute said driving means so that said image sensor may be spotted even

before said image sensor starts the image pick-up of the image light of each primary color.
[0009] If said driving means moves said image sensor based on said data which possessed the storage means for memorizing the data in which the movement magnitude or the location of said image sensor computed beforehand is shown, and were memorized by this storage means, it is convenient.
[0010] Furthermore, the piezoelectric device for moving said image sensor can constitute said driving means.
[0011]
[Function] In the Junji Men color camera concerning the above-mentioned configuration, said image sensor is moved in the direction of an optical axis according to each color of the image light into which the color of said driving means was separated with said color separation filter. It becomes possible to make the image formation location and the image pick-up side of an image sensor by the axial overtone aberration of image pick-up optical system always in agreement by this. For this reason, it becomes possible to remove the effect of a gap of the image formation location by axial overtone aberration, and to obtain the image pick-up image of high quality.
[0012] Moreover, the stable image pick-up is performed during the image pick-up period of the image light of each color by constituting said driving means so that the color boundary of said color separation filter may carry out migration control of said image sensor during the color mixture period which passes through the image pick-up side top of said image sensor.
[0013] Moreover, if the location of said image sensor is performed even before said image sensor starts the image pick-up of the image light of each primary color, having a bad influence on image pick-up actuation of each primary color of said driving means will be lost.
[0014] Furthermore, specifically, said driving means can perform exact and exact control in every color by having a storage means for memorizing the data in which the movement magnitude or the location of said image sensor computed beforehand is shown, and moving an image sensor based on the data memorized by this storage means. Moreover, it becomes possible to correct or change the data memorized by said storage means if needed.
[0015] Moreover, it becomes possible to be able to use the piezoelectric device for moving said image sensor, if it considers as said driving means, to carry out the minute variation rate of the image sensor by this, and to set up the location correctly.
[0016]
[Example] Hereafter, with reference to a drawing, it explains per example of this invention. Drawing 1 shows the configuration of the outline of the frame sequential color camera as one example of the Junji Men color camera of this invention. The camera of this drawing is equipped with the camera section 20 and the frame memory section 21. The camera section 20 possesses the mechanical component 3 which carries out the rotation drive of the color separation filter 2 and this color separation filter 2 for separating the color of the image light which passed along the image pick-up lens 1 which receives the incident light from the photographic subject which is not illustrated, and this image pick-up lens 1, and the rotation detecting element 4 for detecting the rotation phase of a color separation filter 2. The rotation detecting element 4 detects optically the home position marker prepared in the color-separation filter 2 so that it might be constituted by the photo interrupter and might state later.
[0017] The camera section 20 has an image sensor 5 still like a CCD component, the image sensor migration section 6 which moves this image sensor 5 in the direction of an optical axis, the digital disposal circuit 7 for performing a predetermined image processing to the signal acquired from an image sensor 5, and the camera control circuit 8 which controls each part of the camera section 20.
[0018] Moreover, the frame memory section 21 is equipped with the switch section 17 for carrying out the sequential change input of the output of the A/D-conversion circuit 9, the memory control circuit 10, the R image memory 11 which has the capacity which can memorize the image data for the at least 1 field, respectively, the G image memory 12 and the B image memory 13, the D/A conversion circuits 14, 15, and 16, and said A/D-conversion circuit 9 at each memory 11, 12, and 13. Moreover, the output of such the frame memory section 21 is connected to the monitor television 22.
[0019] Drawing 2 shows the detailed configuration of the color separation filter 2 of drawing 1 . The home position marker section 26 which consists of an opaque part for detecting each color fields 23, 24, and 25 where this color separation filter 2 penetrates only each primary colors R (red), G (green), and B (blue) on the disk of one sheet, and the rotation phase of a color separation filter is formed. The rotation drive of this color separation filter 2 is carried out by said filter mechanical component 3 with constant speed in the direction shown by the arrow head A, a detecting element 4 detects said home position marker section 26, and a zero position signal is generated. This zero position signal is sent to the camera control section 8, and the migration signal for

performing migration of the color recognition signal and image sensor 5 which identify each color etc. is generated so that it may explain to a detail later. In addition, in drawing 2 , the dotted-line part 27 shows the image pick-up area by the image sensor 7.

[0020] Moreover, drawing 3 shows signs which carry out back image formation that the color of the image light by which image formation is carried out with the image pick-up lens 1 was separated with such a color-separation filter. Namely, generally, the image formation point with the image pick-up lens 1 serves as a different location for a difference of the wavelength of each primary lights of R, G, and B, and, for this reason, produces axial overtone aberration. Among each primary lights of R, G, and B, the image light of R with the longest wavelength is located in the point from the image pick-up lens 1 that an image formation point is the furthest, and carries out image formation of the image light of B with the shortest wavelength to the location nearest to the image pick-up lens 1. Therefore, an image sensor 5 is moved in the direction of an optical axis by the image sensor migration section 6 in the case of the image pick-up of the image light R, G, and B of each color, and it is controlling by this invention so that the image pick-up side of an image sensor is in agreement with the image formation point of each image light.

[0021] The image sensor migration section 6 is constituted using the piezoelectric device 30 as shown in drawing 4 . The piezoelectric device 30 shown in drawing 4 puts the piezo-electric matter 31, such as the matter in which the piezo-electric effect is shown, for example, barium titanate etc., in the shape of sandwiches with the electrodes 32 and 33 which entered mutually. It expands and contracts by impressing an electrical potential difference V among electrodes 32 and 33 in the direction in which each piezo-electric matter produces expanding or contraction, therefore the thickness of synthesis of a piezoelectric device 30 is shown by this drawing arrow head. Expanding of a piezoelectric device 30 or the magnitude of contraction can be set up by adjusting the electrical potential difference to apply. Therefore, it becomes possible to perform precise migration of said image sensor using such a piezoelectric device 30.

[0022] Drawing 5 shows the concrete structure of the image sensor migration section 6. (a) of this drawing is the front view seen from the image pick-up side of an image sensor 5, and (b) is the sectional view which met the A-A line.

[0023] Such the image sensor migration section 6 has attached the image sensor tie-down plate 35 through two piezoelectric devices 30 on the fixed base 34. An image sensor 5 like CCD has pasted the image sensor tie-down plate 35 with the adhesives which are not illustrated, for example. Moreover, it has penetrated to the guide hole 37 with which three guide pins 36 prepared in the fixed base 34 were formed in the image sensor tie-down plate 35, and positioning of the optical axis of an image sensor 5 and the direction of a right angle etc. is performed. Moreover, the lead pin 38 of an image sensor 5 is connected to the output substrate 39 which consists of the flexible printed circuit boards etc.

[0024] Actuation of the Junji Men color camera which has the above configurations is explained mainly referring to drawing 1 . In drawing 1 , image formation of the incident light from the photographic subject which is not illustrated is carried out to the image pick-up side of an image sensor 5 through the image pick-up lens 1 and a color separation filter 2. The camera control circuit 8 in the camera section 20 controls each part based on the horizontal and Vertical Synchronizing signal which are sent out from the memory control circuit 10 of the frame memory section 21. First, a predetermined control signal is inputted into the filter mechanical component 3, and the rotation drive of the color separation filter 2 is carried out with constant speed. According to rotation of a color separation filter 2, the rotation detecting element 4 detects the home position marker 26 (drawing 2) on a color separation filter 2, generates a zero position signal, and inputs into the camera control circuit 8. The camera control circuit 8 generates and supplies a driving signal, a color recognition signal, etc. for controlling image pick-up actuation of an image sensor 5 while controlling it so that the rotational frequency of a color separation filter 2 serves as a predetermined rate based on this zero position signal. By this, an image sensor 5 generates the picture signal corresponding to the image light of a photographic subject, and inputs it into a digital disposal circuit 7. After a digital disposal circuit 7 performs a predetermined image processing, for example, white balance adjustment, a clamp, a gamma correction, etc. using the color recognition signal inputted into the picture signal inputted from the image sensor 5 from the camera control circuit 8, it is supplied to the frame memory section 21.

[0025] As said drawing 3 showed, in order that the camera control circuit 8 may move an image sensor 5 in the direction of an optical axis (the direction of an arrow head) for every color again, it generates a migration signal and supplies it to the image sensor migration section 6. It is controlled so that a predetermined electrical potential difference is supplied to the piezoelectric device (30, drawing 4 , and drawing 5) for moving an image sensor 5 for every color by this and the image formation location of the image light of each color and the image formation side of an image sensor 5 are in agreement with this. In addition, the camera control circuit 8

memorizes the data in which the required magnitude of the migration signal supplied to the image sensor migration section 6 for every color is shown in predetermined memory like ROM, and it is constituted so that the data of this memory may be read for every color and an image sensor migration signal may be generated.
[0026] In the frame memory section 21, the picture signal inputted from the digital disposal circuit 7 of the camera section 20 is changed into a digital signal in the A/D-conversion circuit 9, and it memorizes to frame memories 11, 12, and 13 one by one for every primary color through the switch section 17.
[0027] And the digital picture signal of each color memorized by each memory 11, 12, and 13 is read to coincidence, is changed into an analog signal by the D/A conversion circuits 14, 15, and 16, respectively, and is supplied to the monitor television 22 as a coincidence type analog RGB signal. A horizontal and Vertical Synchronizing signal H-Vsync are also supplied to the monitor television 22 from the memory control circuit 10, and the display of an image is performed.
[0028] In the case of such actuation, the memory control circuit 10 accepts the color recognition signal sent from the camera control circuit 8 of said camera section 20, and makes the transfer operation of the switch section 17 perform based on these signals, and controls actuation of the data writing to each memory 11, 12, and 13, and data read-out from each memory 11, 12, and 13.
[0029] Drawing 6 shows roughly the signal wave form of each part in the case of the above actuation. In this drawing, (A) shows typically the image pick-up video signal corresponding to the photographic subject image light of G, B, and R whose color was separated with the color separation filter 2. The writing to each image memory of the frame memory section 21 is performed by the color recognition signal (G-ENABLE) of each color shown by (C) generated on the basis of the zero position signal (B) with which such a video signal is shown in (B), (D), and (E), (B-ENABLE), and (R-ENABLE).
[0030] Moreover, (F), (G), and (H) show the position signal for controlling the location of the image sensor 5 of each color. These position signals are constituted so that it may have started in advance of the standup of the corresponding color recognition signal (C) of each color, (D), and (E), therefore an image sensor 5 can be positioned in a predetermined location in advance of acquisition of the video signal of each color, and the writing to an image memory at least. In addition, each position signal (F), (G), and (H) make memory like ROM memorize the data in which the movement magnitude of the image sensor 5 computed beforehand or a location is shown as mentioned above, read the data of this memory for every color, and are generated. Furthermore, when the color boundary of a color separation filter 2 arranges a standup [of each position signal], and falling time during the color mixture period which passes through the image pick-up area of an image sensor, the effect by migration of an image sensor can be prevented from reaching over the whole image pick-up period of an image sensor.
[0031] In addition, in the above example, although the case where a disc-like color-separation turnable filter was used as a color separation filter was shown, a color separation filter may apply other means, such as a method which changes a band-like filter. Moreover, as a means to drive an image sensor, the electromagnetic actuator and others other than the above-mentioned piezoelectric device can also be used.
[0032]
[Effect of the Invention] As mentioned above, according to this invention, in a field sequential color camera, since it constituted so that a gap of the image formation location by axial overtone aberration might be amended by moving an image sensor in the direction of an optical axis, it becomes possible to obtain the image pick-up image of high quality extremely by the easy equipment configuration. Moreover, as compared with the case where the thickness of each color field of a color separation filter is changed, manufacture of a color separation filter becomes easy, and increase of cost can be prevented. Furthermore, since the ununiformity of the weight balance of a color separation filter etc. is not produced, a high-speed rotation drive is also possible, and the high-speed operation of a field sequential color camera also becomes possible easily.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Industrial Application] Especially this invention relates to the Junji Men color camera from which the bad influence by the axial overtone aberration of optical system was removed by moving an image sensor in the direction of an optical axis about a field sequential color camera.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, after separating the color of the image light of a photographic subject with a color separation filter through an image pick-up lens, the Junji Men color camera which picturizes with an image sensor like CCD and acquires a picture signal is known. With such a Junji Men color camera, the color field which makes a color separation filter penetrate only the light of each primary color is prepared, this color separation filter is rotated and the image light for every primary color is obtained. However, generally, since refractive indexes differ according to the wavelength of incident light, an image pick-up lens produces the optical path difference for every primary color, and the difference of a focal location according to the wavelength of incident light. This is the so-called axial overtone aberration, and it produces un-arranging [that the image formation side of a photographic subject image shifts for every primary color also in the case of said Junji Men color camera].

[0003] Conventionally, in order to remove such axial overtone aberration in the plane sequence following color camera, what amends by changing the thickness of the filter field for every primary color of a color separation filter is known (JP,6-54331,A). That is, in the Junji Men color camera of this conventional example, thickness of the filter of red with long wavelength (R) was made thin, and the filter of green with more short wavelength (G) was thickened, and has amended the gap of the focal location by the wavelength of incident light by this.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, in a field sequential color camera, since it constituted so that a gap of the image formation location by axial overtone aberration might be amended by moving an image sensor in the direction of an optical axis, it becomes possible to obtain the image pick-up image of high quality extremely by the easy equipment configuration. Moreover, as compared with the case where the thickness of each color field of a color separation filter is changed, manufacture of a color separation filter becomes easy, and increase of cost can be prevented. Furthermore, since the ununiformity of the weight balance of a color separation filter etc. is not produced, a high-speed rotation drive is also possible, and the high-speed operation of a field sequential color camera also becomes possible easily.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the above conventional Junji Men color cameras, having manufactured what has the filter field where thickness differs for every primary color as a color separation filter, and manufacture of the filter of such structure having un-arranged [that manufacture cost becomes high] to the difficult top. Moreover, since the thickness of a filter differed for every primary color, it was difficult for the weight balance of a color separation filter to become uneven, and for it to become difficult to carry out the rotation drive of the color separation filter at high speed, therefore to realize the Junji Men color camera in which high-speed photography is possible according to such structure.
[0005] that by which this invention was made in view of the trouble in such a conventional camera -- it is -- a plane sequence -- it is in removing the axial overtone aberration of optical system exactly, having it with easy structure, and enabling it to obtain the color picture of high quality in a color [degree] camera.

[Translation done.]

MEANS

[Means for Solving the Problem] The color separation filter for according to this invention, separating the color of the image light of a photographic subject, and obtaining the image light of each primary color, in order to attain the above-mentioned purpose, In the Junji Men color camera which has the image sensor which carries out the sequential image pick-up of the image light of each primary color obtained with this color separation filter, and is changed into an electrical signal In order to remove the axial overtone aberration for every color of the image light whose color was separated with said color separation filter, the driving means which moves said image sensor in the direction of an optical axis corresponding to each color is established.
[0007] Said driving means is convenient if the color boundary of said color separation filter carries out migration control of said image sensor during the color mixture period which passes through the image pick-up screen top of said image sensor.
[0008] What is necessary is just to constitute said driving means so that said image sensor may be spotted even before said image sensor starts the image pick-up of the image light of each primary color.
[0009] If said driving means moves said image sensor based on said data which possessed the storage means for memorizing the data in which the movement magnitude or the location of said image sensor computed beforehand is shown, and were memorized by this storage means, it is convenient.
[0010] Furthermore, the piezoelectric device for moving said image sensor can constitute said driving means.

[Translation done.]

OPERATION

[Function] In the Junji Men color camera concerning the above-mentioned configuration, said image sensor is moved in the direction of an optical axis according to each color of the image light into which the color of said driving means was separated with said color separation filter. It becomes possible to make the image formation location and the image pick-up side of an image sensor by the axial overtone aberration of image pick-up optical system always in agreement by this. For this reason, it becomes possible to remove the effect of a gap of the image formation location by axial overtone aberration, and to obtain the image pick-up image of high quality.

[0012] Moreover, the stable image pick-up is performed during the image pick-up period of the image light of each color by constituting said driving means so that the color boundary of said color separation filter may carry out migration control of said image sensor during the color mixture period which passes through the image pick-up side top of said image sensor.

[0013] Moreover, if the location of said image sensor is performed even before said image sensor starts the image pick-up of the image light of each primary color, having a bad influence on image pick-up actuation of each primary color of said driving means will be lost.

[0014] Furthermore, specifically, said driving means can perform exact and exact control in every color by having a storage means for memorizing the data in which the movement magnitude or the location of said image sensor computed beforehand is shown, and moving an image sensor based on the data memorized by this storage means. Moreover, it becomes possible to correct or change the data memorized by said storage means if needed.

[0015] Moreover, it becomes possible to be able to use the piezoelectric device for moving said image sensor, if it considers as said driving means, to carry out the minute variation rate of the image sensor by this, and to set up the location correctly.

[Translation done.]

DESCRIPTION OF DRAWINGS

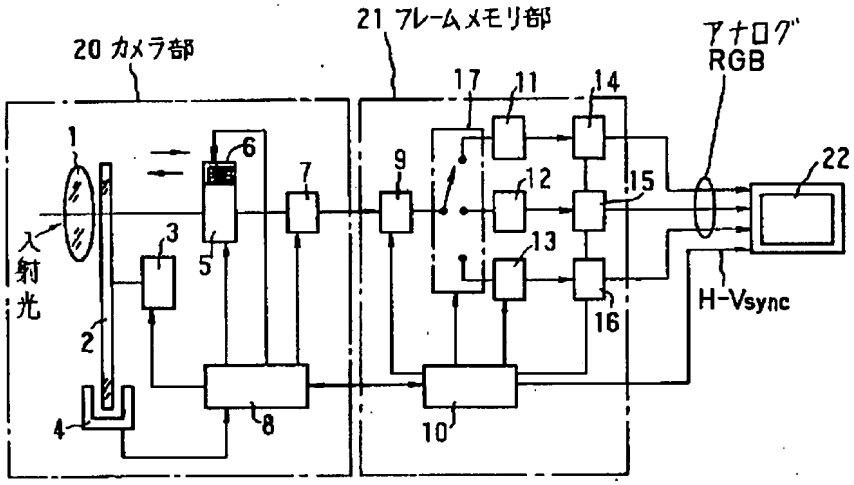
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the outline of the Junji Men color camera concerning one example of this invention.
[Drawing 2] It is the front view showing the configuration of the color separation filter currently used for the Junji Men color camera of drawing 1 .
[Drawing 3] It is the explanatory view showing a gap of the image formation point by the axial overtone aberration for every color in the Junji Men color camera of drawing 1 .
[Drawing 4] It is the theoretic explanatory view showing the configuration of the piezoelectric device used for migration of an image sensor in the Junji Men color camera of drawing 1 .
[Drawing 5] It is the sectional view (b) seen from the front view (a) and A-A line which show the concrete configuration of the image sensor migration section currently used for the Junji Men color camera of drawing 1 .
[Drawing 6] It is the rough wave form chart showing the signal of each part of a Junji Men color camera of drawing 1 .
[Description of Notations]
1 Image Pick-up Lens
2 Color Separation Filter
3 Color Separation Filter Mechanical Component
4 Rotation Detecting Element
5 Image Sensor
6 Image Sensor Migration Section
7 Digital Disposal Circuit
8 Camera Control Circuit
9 A/D-Conversion Circuit
10 Memory Control Circuit
11 R Memory
12 G Memory
13 B Memory
14, 15, 16 D/A conversion circuit
17 Switch Section
20 Camera Section
21 Frame Memory Section
22 Monitor Television
23, 24, 25 Migration field
26 Home Position Marker
27 Image Pick-up Area
30 Piezoelectric Device
31 Piezoelectric Crystal
32 33 Electrode
34 Stationary Plate
35 Tie-down Plate
36 Guide Pin
37 Guide Hole
38 Output Lead

39 Output Substrate

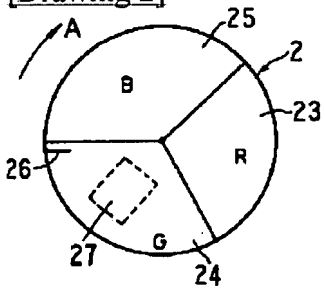
[Translation done.]

DRAWINGS

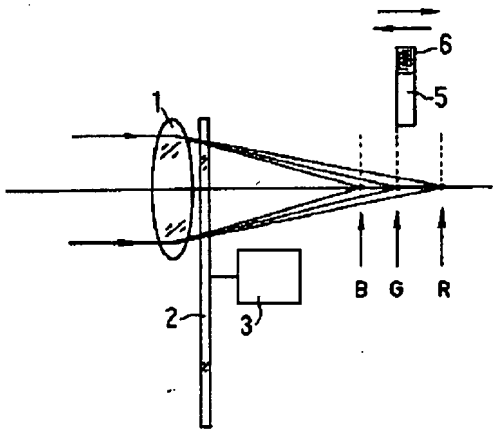
[Drawing 1]



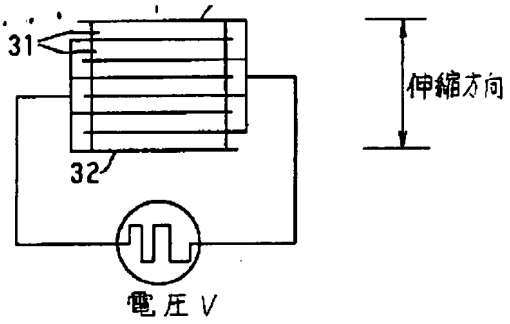
[Drawing 2]



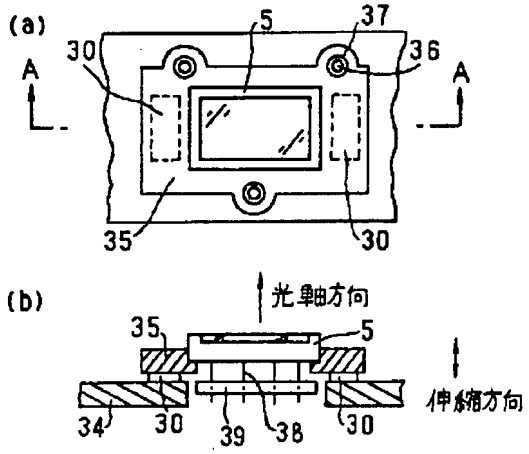
[Drawing 3]



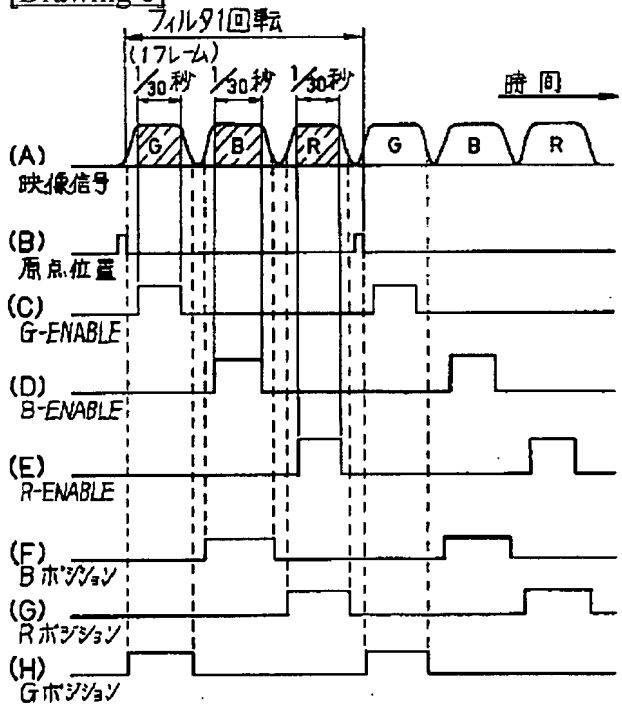
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]